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The Tech Engineering News

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Ernest Fox Nichols

OUR NEXT PRESIDENT

See page 7

VOL. II APRIL, 1921 No. 1

The WORLD'S WORD for ELEVATOR SAFETY

The WORLD'S WORD for ELEVATOR SAFETY

BAHIA

PILAR INCLINE

CITY OF BAHIA, BRAZIL

BAHIA is divided into an Upper and a Lower City. One section is on the top of a cliff—the other extends between the foot of the cliff and the waterfront.

Four Otis Electric Elevators in two large vertical towers and the Otis Incline Railway pictured here, carry the people and freight up and down the cliff. The Incline Railway is built at an angle of 40 degrees; there are two cars working alternately, each with a capacity of 20 people and 1500 pounds freight and the trip is made in 90 seconds.

Otis engineering has successfully linked these two parts of Bahia. This achievement, big as it is, is but one significant detail of the world-wide service given by Otis.

Most of the famous structures of the world are equipped with Otis Elevators.

OTIS ELEVATOR COMPANY

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MAN'S UPWARD CLIMB

By HERVEY W. SHIMER
Associate Professor of Paleontology, M. I. T.

It has been said that both man and woman sprang from the monkey, but that woman sprang farther. However much we may doubt the latter part of this statement the fact remains that this jump has been the topic of much scientific discussion, and has been the cause of some very interesting scientific theories. Professor Shimer shows that this evolutionary jump has greatly separated man from his ancestral brute.—Editor.

The climb of man upward from his brute ancestors has been long, and he carries with him today much that is reminiscent of his past likenesses to other members of the great class of mammals and still more lowly forms. Such likenesses, pointing to a common descent, we see over and over again in this world, whose one great law is that of evolution.

The similarity of Spanish, Italian and French in word forms argues a kinship between these languages, a similar ancestry for them. This is corroborated by the fact that their more and more ancient literatures lead step by step back into the fossil language, Latin.

Just as the similarity of the Romance languages argues a common ancestry, so the great number of features in common between the different mammals argues a common ancestry for this entire class of animals. In the figure this likeness is shown in the bones of the posterior limb of five mammals. The ball at the top of the thigh bone (2) fits into the socket of the hip. The knee-cap (3) is similar in place and function. The bones of the lower leg (4) consist of the large shinbone (a) and a smaller bone (b) beside it; this latter becomes very small in the horse and sheep but does not disappear. The ankle joint (5) is naturally raised above the ground in all animals that walk upon the tips of their toes, as do the sheep and horse, which brings the heel bone correspondingly high. The horse developing upon our western plains, in response to the necessity for speed, ended by walking on the ends of his toes, but this change, though it caused the loss of side toes and the lengthening of the middle one, produced no basic change in the bones of the body. The other ankle bones occur also in the same relative positions in all of the mammals. The number of toe joints is the same, but there is a reduction in the number of toes from their normal number five in man to one in the horse; but a fourteen inch long embryo of the horse has three toes, harking back to its three-toed, and before that, its five-toed ancestors. The nail of man is flat as it also is in the horse, but since the weight of the horse rests upon the nail it becomes very broad and strong, investing the end of the terminal bone, forming the hoof. In the dog the nail is narrowed into the claw. A correspondingly close resemblance exists between all of the other bones of the body.

EOLITHIC MAN

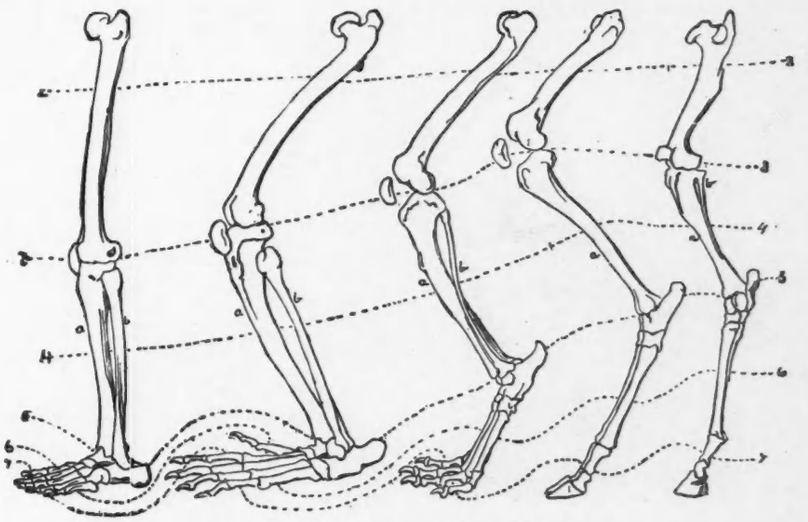
"A man, for aye removed from the developed brute; a God though in the germ."—*Browning.*

Not only do mammals possess similar bones but their muscles, blood vessels, digestive organs and nerves are just as similar in position, function and derivation. For example, over 400 of the muscles found in the cat's body occur also in man with the same general location, function and nerve supply.

Man, horse, cat, and all other mammals have these basic bones, muscles, and nerves similar because of a common brute ancestor which possessed them. This is corroborated by the fact that their more and more ancient fossil remains lead step by step back into this common fossil ancestor. Has man inherited mental as well as physical traits from his brute ancestors? Does he still at times act brutishly because his manlike traits have been superadded to the typical brutish ones so comparatively recently that they at times fail to control the more primitive impulses and desires?

That which makes man a man, as distinct from the beast, is self-consciousness and reason. These characteristics are due either to a gradual and natural development from the brute, or are the

(*Continued on Page 12*)



POSTERIOR LIMB OF FIVE MAMMALS

Man's relationship to other mammals is shown in the similarity of the skeletons.

CONCRETE ROAD CONSTRUCTION

By GEORGE A. CURTIS '04
District Engineer, Division of Highways, Pittsfield, Mass.

In presenting this subject it may not be amiss to consider briefly the factors which enter into the choice of concrete as the proper type of building material. These factors include: (1) the average annual cost; (2) the possible use of the old road as a foundation for bituminous or other surface, after the original has become unsatisfactory; (3) the ease of maintainance; (4) the character of the ground over which the road is built.

A road that is subject to freshet conditions is likely to deteriorate very rapidly, but concrete road is especially adapted to these conditions. Furthermore, the tractive resistance on concrete roads is usually low.

Having chosen this type, we will now consider the determining factors which will give the best results for the money expended.

Location, Fine, and Grade

Although the principles involved are not different from those in other types of construction, it should be borne in mind that this surface is perhaps of a more permanent character and should receive more careful attention. Attempt should be made to keep the curves of as large a radius as practical, and to avoid reverses. It is desirable to maintain an unobstructed view of at least 200 ft. from any point along the travelled way.

Drainage, Foundation, and Subgrade

The word drainage in this connection should always be spelled with a capital D. It is, by all engineers, agreed to be the most important phase of road building.

Our object is to obtain, as nearly as local and financial conditions will permit, a dry foundation that will furnish a uniform bearing power for the pavement. Special emphasis should be placed on the word "uniform." All soils heave to a greater or lesser degree, but the non-uniformity of heaving due to the varying textures of the materials forming the subgrade, is what causes the concrete to crack badly. Clay is known to heave excessively, but if the subgrade is composed entirely of this material, such as is the case in some of our western states, no particular trouble will be experienced, as the entire road heaves uniformly.

ROAD CONSTRUCTION
A typical stretch of concrete road partially completed.

In general, concrete should not be built on any except the shallowest fill, even though built up in thin layers and thoroughly rolled, unless the embankment is so placed in the fall, with the idea of concreting over it as a subgrade the next year. Care should be taken before concreting to loosen up the surface for the depth of 6 inches or more and re-roll. This is for the reason that the center will have become more compact by the travel than the sides and so will settle non-uniformly after the concrete is laid, unless this precaution is taken.

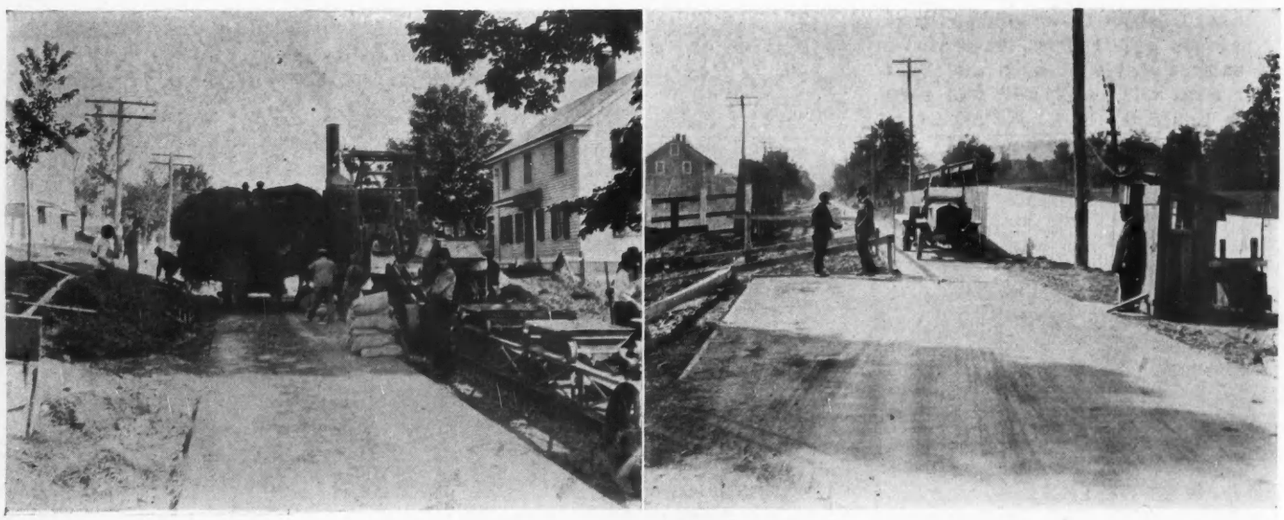
Drainage is composed of 3 items: water flowing to the road from outside areas; rain falling on the road itself; and underground water. The governing thought should be to care for the water quickly, thus lessening the effects of alternate freezing and thawing, saturation and drying out of the soil.

The best method of applying concrete may be summarized as follows:

For a light soil, lay the concrete directly on the subgrade, being careful to see that the subgrade is clean, and use a side ditch, the bottom of which is slightly lower than the bottom of the concrete.

For a medium soil use about 3 inches of clean gravel or cinders under the concrete in connection with the open ditch, the bottom of which is lower than the gravel course.

For heavy soils use not over a six inch layer of porous material under the concrete and an open ditch or blind drain of sufficient depth to quickly drain this and lower as much as possible the level of the ground water. The porous material used under the concrete should extend entirely through the shoulders.



SCENES DURING CONSTRUCTION
This illustrates how only one side of the road is closed to traffic.

Cross Section

Our best practice would seem to indicate that for our main roads, the width should be from 18 to 20 ft. with a thickness of 6 inches at the side and about 8 inches at the center. The crown, of approximately ¼ inch per foot, is in the form of the arc of a circle.

Secondary roads may be up to 18 ft. in width, 5 inches thick at the side, and about 7 inches at the center.

Aggregates and Proportions of the Mix

As the life of the concrete depends primarily on the quality of the materials of which it is composed, too great care cannot be exercised in their choice. All available approved methods of testing should be utilized. Samples of sand should be collected and forwarded for laboratory tests.

test is useful in determining the comparative resistance of the rock to the impact such as produced by the action of horses' hoofs. Uniformity in the qualities of these aggregates is very important in order that the pavement should wear evenly.

The grading has always been disposed of in our work by arbitrarily calling for the proportions as 1: 2½: 5. 1: 2: 4, etc. If one inch stone is available the same proportion is used as if two inch stone were used, although the percent of voids in the two may vary considerably. Tests have shown that with a given proportion of cement, wide variation in the quality of the concrete can be had from differences in grading of the aggregates.

The addition of hydrated lime makes the concrete more impervious. Amounts

Before placing the concrete the subgrade should be thoroughly wet. Forms of a depth equal to the full side depth of the concrete should be used, the same being firmly and accurately set for line and grade.

After the material is deposited on the subgrade, it should be levelled and screeded as soon as possible with a template cut to the desired crown of the finished surface. Any depression then occurring should be filled and the whole re-screeded.

Immediately after the concrete has set, it should be rolled to get rid of the excess water. This rolling should be done at least twice, with only a short interval between rollings. The surface is now ready to be finished with the belt, a method which is strongly recommended. About one-half hour later

LAYING THE CONCRETE

Showing how concrete is carried from mixer to workmen who lay it.

MAKING THE CROWN

Illustrating the use of the template.

This sand when mixed with cement to make a 1 to 3 mortar should show a tensile strength at least equal to that of standard sand, similarly mixed.

The quality of the stone should be obtained by forwarding test samples to the Department of Agriculture, Bureau of Public Roads, at Washington. The two principal tests to which it is there subjected are the Deval abrasion test, and the toughness test. The Deval test is made to determine the percent of wear and the French coefficient of wear. This is accomplished by placing the samples in a cylindrical drum which is given 10,000 revolutions, after which the loss in weight due to wear is determined. The French coefficient is then stated as 40 divided by the percent of wear. Standard practice demands that this coefficient shall be not less than 8.

The toughness test is made to determine the resistance which the material offers to fracture due to impact. This

up to about 10 percent tend to increase the strength somewhat when the mix is of dry consistency. The addition of 15 percent tends to lower the strength.

Mixing, Placing, and Finishing

The main points to look after in the mix are the amount of water used and the time of mixing. A large number of tests have conclusively proved that the strongest concrete is obtained with a rather dry mix, further described as one which will not tend to make the inspector over popular with the men operating the screen. An increase in the amount of water used very materially decreases the strength.

As tests show a practically uniform increase in strength with increased time of mixing up to a full minute and only slight additional increases for longer mixing, it is considered that one minute should be specified as the required time.

the surface is slightly roughened transversely by brooming lightly with an ordinary rattan push broom. This is done in order to give a slightly rougher surface and make the pavement less slippery.

Curing

The method to be employed is dependent on the temperature. In exceedingly warm weather when the sun is very bright, it may be necessary to use a canvas protection until the surface has set sufficiently to receive the covering which is to be left on for a period of about two weeks. This covering may be of hay, straw, sawdust, or earth and should be kept wet during this period.

In level country curing by the ponding method is successfully used. This is accomplished by building little dikes so that the pavement may be flooded to a depth of about 2 inches over the

(Continued on Page 20)

CO-OPERATIVE ENGINEERING

By W. F. HAEHNLE

Professor of English, College of Engineering and Commerce of the University of Cincinnati

The Schneider plan of co-operative engineering of which the College of Engineering of the University of Cincinnati has been one of the foremost exponents since 1906, has not only effectively solved the problem of co-ordinating theoretical training with practical factory work, but has also prompted correlation of the various courses of study to a degree unknown in most scientific schools. The plan was originally adopted to present to the student, simultaneously with his studies, the difficulties met in the application to the industries so that he would more clearly understand the mutual interests that bind the two together.

The college is, of course, most interested in the educational value of a student's co-operative job. Consequently the question of wages is not permitted to interfere with the important work of the co-ordinator, whose task it is to see that every co-operative student under his supervision is engaged in the kind of work that will best prepare him for his profession. When a student has exhausted the possibilities of one job, he is advanced to another. As a consequence of this gradual promotion, the majority of the students taking the co-operative course are in positions of some responsibility during their last few years, and they are paid wages which enable many of them to be self-supporting. It often happens that the change from school to professional life means only a cessation of class-room work and the assumption of full-time instead of half-time duties with the same firm.

The factor that has arisen from this plan, which is most novel to the world of technical education, is the development of the interrelationships that exist between the various subjects of instruction. The fundamental courses given in the first two years are developed from a small body of basic priciples which are emphasized repeatedly in the various problems to which they apply. Thus, in the first year, mathematics, mechanics (statistics), and drawing are frequently brought into intimate contact. A problem in mechanics may be solved as a problem in trigonometry, and at the same time by a graphic construction on a drawing plate; a problem that arises in physics and dynamics is used as an application of the calculus.

In brief, the courses in which this has been practised comprise two principal groups; in the first year, elementary mathematics, statistics, and engineering drawing; in the second, the calculus, dynamics, and physics. The philosophy of the system of correlation is given in the report of the committee on mathematics and sciences, headed by Professor R. C. Gowdy of the Department of Mathematics and Professor Louis Brand of the Department of Physics. A brief summary of the report on the correlation of studies during the first year follows:

In order to obtain the maximum of synchronized correlation among the fundamental Engineering studies during the first year, three courses have been recommended. The first of these is a course in elementary statistics, the second covers the essentials of elementary algebra, trigonometry and analytic geometry, and the third is mechanical drawing and descriptive geometry. In the sophomore year, the coordinations are even greater, because they involve calculus, physics, mechanics, and engineering design. It should be apparent that in this year particularly the interweaving of the different theories can be brought to the highest stages of success.

The trial of the system so far this year indicates a very satisfying advantage over the old method. There is no doubt that the fundamental principles of mathematics and sciences become a part of the student's working equipment and do not remain abstract theories. It has been found further that with more rigorous requirements in daily classroom work, there has been a decrease in student mortality which can be accounted for only by the fact that the correlations permit a student to grasp the principles taught. All courses of instruction during the first two years are nearly iden tical. The courses vary appreciably in the summer following the second year, however, and diverge more and more throughout the third, fourth, and fifth years.

In April, 1919, following the merging of the College of Commerce with the College of Engineering, the co-operative plan was extended to include commercial training. The course in Commerce, like that in Engineering, is five years in length and operates eleven months during the year. The courses of study for the first two years are exactly the same as those pursued by the engineering students. After this period, the student receives his advanced training in marketing, accounting, finance, business law, world geography, and other commercial subjects.

The course was started as a result of the demands of industries for men who know both production and commercial work, and who have a thorough training in the sciences underlying both. Hence, the outside work is done mainly in the large industrial firms. The student spends his first two years in production departments and the subsequent years in commercial departments. The response, both from the students and from the firms, has been significant. Industries with which the College had been doing business promised enough co-operation to meet the demands for a number of years to come.

Although the actual school time in the five-year co-operative course is only 81 per cent of that in a regular four-year course in engineering, the co-operative students advance further in the theoretical field than do the regular students by reason of the fact that the work during the bi-weekly period is more intensive.

Another obvious advantage from the point of view of the college is that the University plant and the instruction staff can take care of approximately twice as many students as under the continuous plan. Further economies are made possible by the elimination of practice shops. This means that more money is available for salaries and for the equipment of scientific laboratories, and makes for a more efficient mode of instruction and a higher standard of graduation.

HOW ABOUT M.I.T.?

Student participation in all branches of extra-curriculum activities is heartily encouraged by the faculty of the University of Cincinnati Engineering College. In order to facilitate this, the Faculty of the College has decided that the hour from one until two every day shall be devoted to extra-curriculum affairs. During this period, every student in the College will be engaged in some form of activity, a form which has been chosen by him. This plan is based on the physiological fact that a student can do more effective work during a seven-hour day, if the intensive work of the four-hour morning period is separated from that of the afternoon by an hour of relaxation. To promote this, the students in the several departments have their own clubs, which meet once a week to discuss technical problems that arise in connection with the outside work done by the students. Opportunity is given in these meetings for that extemporaneous discussion which will prepare the student for effective oral expression.

A chain breaks at its weakest link. To prevent electrical apparatus from burning up in service, an electrical weak link in the form of a fuse is inserted in the circuit. When the inductance of the circuit is excessive there is apt to be an arc produced when the fuse melts. To extinguish the arc the fuse is made a part of a magnetic circuit so that when the fuse melts, there is sufficient flux to extinguish the arc. It follows that the greater the current the greater will be the flux; as the solenoids are an integral part of the fuse box, it frequently happens that a given box will blow out the arc from a five hundred ampere fuse more easily than it will that from a fuse designed to melt under a current of only one hundred amperes. The limit of a fuse for use with a given fuse box is a minimum rather than a maximum.

DR. ERNEST FOX NICHOLS

TECHNOLOGY'S NEXT PRESIDENT

On March 30, 1921, Dr. Ernest Fox Nichols was elected President of Technology. Through his appointment, Technology is about to receive another great scientist and educator.

From his youth, Dr. Nichols has been interested in science and by his industrious and versatile researches, he has become one of the foremost investigators of his day. But not only in research has he been recognized as a power. His keen foresight and executive ability have placed him in many administrative positions of importance. This ability was markedly demonstrated when he undertook the re-organization of the Physics Department at Dartmouth during his Professorship there. Under his efficient leadership the department became one of the strongest in the College. These abilities both as a research investigator and as an efficient administrator make Dr. Nichols doubly fitted to assume the leadership of Technology and to guide her on her new plans of service.

It is worthy of note that Dr. Rogers founded Technology with the belief that scientific and technical studies were a requisite for a thorough education. Dr. Nichols has proven the truth of Dr. Rogers' statements for, although he never received an Arts Degree, Dartmouth called him to be her President. This was a declaration of the fact that a great scientist could be as fit a man to govern an academic institution as a man of classical training.

A brief review of the many activities of Dr. Nichols will lead to a better realization of his great accomplishments.

He was born at Leavenworth, Kansas, June 1, 1869. In 1888 at the age of 19 he received his B.S. from Kansas Agricultural College. The following year he spent in teaching in the West. Then for several years he took work in mathematics and Physics at Cornell University. He was rewarded with the degree of Master of Science in 1893 and in 1897 the degree of Doctor of Science. While at Cornell he held the Erasmus Brooks Fellowship.

In 1892, Dr. Nichols was called to Colgate University where he occupied the chair of Astronomy and Physics for six years. While there he began his work on stellar and solar problems for which he later became famous. Two of these six years he spent in Germany where he studied under Professors Planck and Rubens of the University of Berlin. While studying there, he improved the Crookes radiometer, developing it to the high state in which it occurs today. With this he was able to carry on experiments for the measurement of the speed of light and the planetary heats all of which is far beyond the average lay mind. His works while in Berlin were received and published by the Royal Prussian Academy of Sciences.

In collaboration with Professor Rubens, he carried out a very difficult and laborious research which was published as "Certain Properties of Heat Waves of Great Wave-length." This was a revolutionizing piece of work and was characterized by his balanced and analytical method of procedure. It was made possible only through the greatly improved instruments which he had invented and led physicists to an entirely new method of attack on the subject.

March 30, 1921.

Leonard Metcalf,
14 Beacon Street, Boston, Mass.

Very deeply appreciate your kind telegram and its cordial greeting from Technology Alumni. The proved devotion and loyalty of Technology men is at once an inspiration and a challenge to her new president.

E. F. Nichols.

Cleveland, Ohio.

In 1896 and 1897, after his return to America, Dr. Nichols used his newly developed radiometer at the Yerkes and at the Mount Wilson Observatories in California. Here he successfully measured the quantity of heat reaching the earth from Acturus and Vega, and also from Jupiter and Saturn; i.e., from fixed stars and from planets. The radiometer which he used was so sensitive that it could easily have detected the heat from a candle at a distance of sixteen miles.

Dartmouth College appointed Dr. Nichols head of the Physics Department in 1898. His success as an organizer there has already been mentioned. In the realm of research, his successes were even greater. In the Wilder Laboratory he worked in conjunction with Associate Professor Hull on further measurement of heat values from planetary bodies.

After several attempts, he succeeded in 1901 in measuring the pressure of a beam of light. This had been detected by other physicists, but had never been measured. The research won him world-wide recognition. During this period he also made important contributions to the radio-active and the electro-magnetic theories.

Columbia University called Dr. Nichols from Dartmouth in 1903, but before leaving, he was given the honorary degree of Doctor of Science by Dartmouth. In Columbia, and later as a lecturing Professor he continued valuable research. For two years he was made Ernest Kempton Adams Research Fellow. He remained at Columbia until 1909.

In this year he was again called to Dartmouth, this time to become its President. During Dr. Nichols' inaugural exercises Dartmouth bestowed the honorary degree of Doctor of Science upon the late President Maclaurin. It was at this occasion that President Maclaurin said of Dr. Nichols:

"I am intimately acquainted with Professor Nichols, as I have been associated with him at Columbia during all my connection there. I could not imagine a better man for the place. He is dignified in bearing, but warm-hearted—the type of man to have keen personal interest in the students, yet without too great familiarity. He is a man of high scientific attainments, broad human sympathy and pleasing personality in every way. He is of the quiet type that knows his own mind and how to carry out his ideas in a quiet, forceful way. And not only does he possess a profound knowledge of science, but he also has a deep appreciation of literature and art."

After seven years of service at Dartmouth he went to Yale University as Professor of Physics where he remained until 1920. From 1917 to 1919 he served in the Bureau of Naval Ordinance where he carried on important research work chiefly on optical instruments. During the last year he has been made Director of Physical Science at the Nela Park Research Laboratory.

Among the honorary degrees which he holds are Doctor of Science from Dartmouth, University of Vermont, University of Pittsburgh, and Dennison; LL.D. from Colgate, Clark, and Wesleyan.

He is the possessor of the Rumford Medal of the American Academy of Arts and Sciences, and is a member of the National Academy of Sciences, of the American Philosophic Society, of the American Physical Society, the American Astronomical Society, and the Washington Academy of Sciences. He is a collaborator of the "Astrophysical Journal," and an associate editor of the "Physical Review."

These facts prove better than words the great preparation of achievement Dr. Nichols brings with him.

It might prove of interest to learn the opinions of Dr. Nichols on matters of everyday college life and experience. In regard to the purpose and ideals of a college Dr. Nichols states:

"To all it should give sound training in those analytical powers of reason upon which sane judgment must ever rely for its validity and it should offer that knowledge of economic, social, and political problems essential to enlightened and effective citizenship. The college should aid its students to understand what man

(Continued on Page 14)

WELDING OF WROUGHT IRON PIPE

By H. D. ELVIDGE
Reading Iron Company, Reading, Pa.

Welded pipe is made either by the buttweld or the lapweld process. Buttweld pipe is made from ⅛ up to 2 inches, and lapweld from 1¼ up to 20 inches, inclusive. In making buttweld pipe, skelp of the correct width, guage, and length is received at the pipe mill, and the corners from one end are cut off, forming a spear point. This skelp is now charged point first into the welding furnace and after it has been heated to the proper welding temperature, is drawn by means of tongs, gripping the spear point, through a die in the shape of a bell so that the edges of the skelp are slowly bent up until they are forced squarely together and are firmly welded. The welded pipe now passes through the sizing rolls and up the cooling table. By the time it reaches the top of this table, it is sufficiently cool to permit handling. After the crop ends are cut off, the pipe is threaded and is now tested with 750 pounds hydrostatic pressure.

Manufacture of Lapweld Pipe

The lapweld process consists of two operations. First, bending the heated skelp into its preliminary shape, and second, welding the bent skelp into pipe. Skelp of the correct guage, width, and length is charged into the bending furnace, brought to the correct temperature and passed through the scarfing rolls. These rolls bevel the edges of the skelp so that when overlapped and welded there will be no undue thickness at the weld. The skelp is now drawn through the bending dies which give it a rough cylindrical shape with overlapping edges, after which it is charged into the welding furnace. It stays in this furnace until the metal has come to the proper welding temperature, when it is shoved out from the back of the furnace into the welding rolls. Each of these rolls has a semi-circular groove, the two rolls forming a circular pass—the diameter of which equals the outside diameter of the pipe. A pipe ball is held on the end of a rod between the two rolls, so that as the bent skelp comes through the rolls, the overlapping edges are subjected to compression between the rolls on top and bottom, and the pipe ball within. The result is a perfect bond or weld, and, due to the beveled edges, the weld has been reduced to the same thickness as the edge of the pipe.

"PIPE" METHODS

As we announced in the last issue, Mr. H. D. Elvidge has prepared another article on the topic of wrought iron pipe. This time, the article has to do with the two principle methods of welding the pipe, namely: the Buttweld and Lapweld processes. This article explains how flat metal strips are welded into pipe.—Editor.

Double Welding

All lapweld pipe and charcoal iron tubes are double welded, i.e., are subjected to a second run through the furnace and welding rolls to insure a more perfect and uniform product than results from the ordinary single run.

The course of operation consists in first passing the bent-up skelp through a pair of welding rolls at a thorough welding heat, immediately returning same to furnace for reheating (after first reversing the pipe, the object of which is to improve the quality of the pipe in its second run by working the metal in an opposite direction). After the pipe has been sufficiently reheated, it is then passed into the second pair of welding rolls beside the first pair and of sufficiently smaller diameter to work the metal down instead of up, as is done in the "single-run" furnaces. This tendency in the "two-run" furnace to work the metal down presents marked advantages over the "single-run" furnaces in which the single run is bound to strain the metal and the weld.

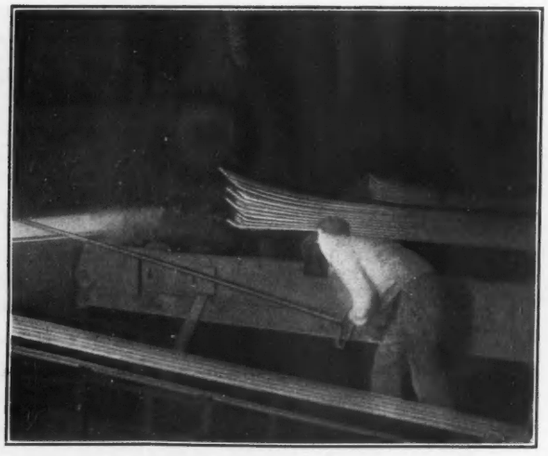
The pipe now enters another pair of rolls, similar in design to the welding rolls, known as the sizing rolls. These rolls correct any irregularities in shape and give the pipe the exact outside diameter required.

The last pass is through the cross rolls (or straightening rolls) consisting of two rolls set with their axes askew. These rolls average 12 feet in length, and are so set or curved that the pipe comes in contact with each for the full length of the roll. As the pipe moves forward in the rolls it is rapidly rotated as the rolls revolve. The pipe leaves these rolls comparatively straight and free from mill scale. After this operation the pipe travels up an inclined cooling table.

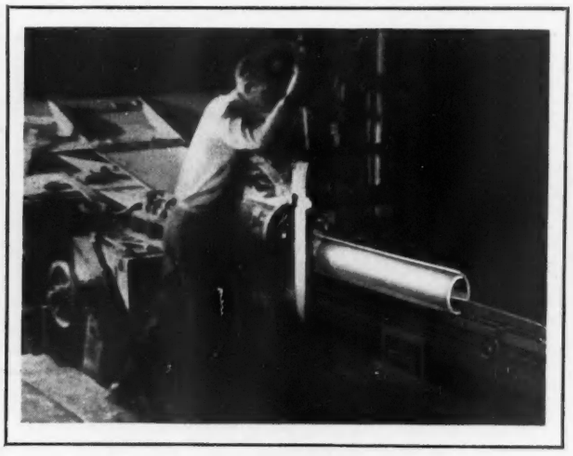
Tests

After the uneven ends of the pipe have been removed on rotary cut-off machines, the pipe is threaded and then each length is tested with from 500 to 3,000 pounds hydrostatic pressure per square inch, depending on the kind and size of pipe. After a final inspection for surface defects, etc., the pipe is ready for shipment.

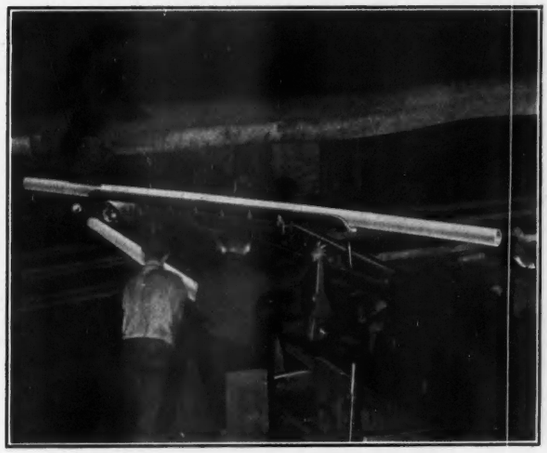
The great test of any pipe is its ability to withstand corrosion, and the bending, torsional and vibratory stresses incident to certain types of service. The



CHARGING SKELP INTO REAR OF BUTTWELD FURNACE. NOTE SPEAR POINT

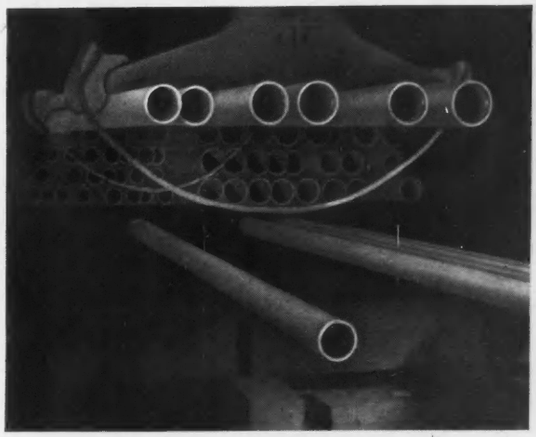


BENDING DIE—LAPWELD PROCESS



VIEW OF LAPWELD FURNACE

The pipe is being turned end for end preparatory to second passage through welding rolls.



MAGNET CRANE—SHIPPING FLOOR

Here pipe in 552 different sizes is shipped to every part of the world.

difference between wrought iron and steel is due to the composition and proportion of the remaining ingredients (other than iron) and principally to the difference of their physical structures.

The primary requisites for a good pipe are uniformity, good welding qualities, and ability to withstand corrosion. Wrought iron pipe possesses all three of these requirements. Wrought iron is made in small unit quantities, and throughout the refining and solidifying stage the metal is constantly worked or puddled. Because of the small quantities of metal and the manner in which it is worked throughout the process, wrought iron is noted for its purity, uniformity, and the absence of any segregation of impurities.

The slag, which is thoroughly distributed throughout the iron, acts as a natural flux, and is largely responsible for the superior welding qualities of wrought iron. In welding steel for commercial purposes, a flux, usually borax, is always used. The sole exception to this practice is welded steel pipe where this fluxing process is not mechanically possible.

The amount of slag varies from four to six per cent by volume. Several hundred thousand of the filaments are distributed over one square inch of metal section so that the structure may be likened to a fine-meshed screen in which the strands of wire or filament would be 1-500 to 1-1000 inch apart. Owing to the close formation of these slag filaments, the continued attacks of corrosion are greatly interfered with; in other words, the path of corrosion through the metal is retarded and lengthened parallel with its surface, thus greatly increasing the time of penetration.

Cost

Due to the small unit quantities in which wrought iron is made, the cost of production is decidedly higher than that of steel pipe. The Reading Iron Company operates the equivalent of 335 single puddle furnaces, which, when fully manned, require 1400 men. Yet at maximum capacity this extensive equipment cannot produce tonnage equal to that of only five 80-ton open-hearth steel furnaces, which require but 30 men in operation. The puddling process, however, is the only known means of producing sinewy, corrosion-resisting wrought iron and will continue, in spite of its higher cost, as long as engineers and architects count the ultimate cost of pipe in years of service rather than the apparent saving in initial cost.

COMMERCIAL EFFICIENCY IN ENGINEERING WORK

By HARRY M. HOPE

It goes without saying that the objective of every ambitious engineering undergraduate is to acquire, while at college, a thorough knowledge of the principles and laws governing his chosen profession. This desire is uppermost and leads the student to emphasize perhaps the relative importance of technical studies over the more practical subjects which the college curriculum usually provides. Of the latter, those relating to the commercial and financial aspects of engineering work are most necessary.

It is difficult, if not well nigh impossible, for the student to develop an appreciation of the term "commercial efficiency" when entirely engrossed with the pursuit of technical subjects. The tendency, almost invariably, of the young graduate engineer, is to strive for the maximum of mechanical, thermal, or electrical efficiency, without maintaining the proper balance with commercial and financial considerations. Quite often the amazing fact is encountered that a proposed plan of operation shown by engineering calculations to be most efficient, actually turns out a more costly product while another plan by similar calculations is obviously less efficient. The "over-all" or "commercial efficiency" in dollars per unit output is the measure of successful engineering work.

As illustrating this point, consider the following example: A steam power plant recently designed, produces a kilowatt hour for 1.75 pounds coal. It was possible, by using larger boilers and condensers to reduce the coal consumption per kilowatt hour to 1.60 lbs. or less, thereby improving greatly the thermal efficiency of the plant, but by so doing, the actual cost of the energy produced would be higher, because the fixed charges on the additional investment would more than offset the saving made by the lower fuel consumption. In other words, the "commercial efficiency" of the plant would be lower.

It should be observed that while commercial considerations are all-important, the determination of the true commercial economy of any project must be based on most precise engineering calculations. In making such calculations, the engineering graduate has no difficulty. Their proper commercial application requires study, sound judgment and experience. In the assembly and analysis of all factors affecting the determination of engineering problems, the engineer must utilize to the utmost the theoretical knowledge he has acquired in school, but never lose sight of the fact that his real objective is to produce desired results at minimum cost.

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ARE TECH COEDS INHUMAN?

The fact that both Tech men and Tech professors are human has been fairly well established. When the question of coeds presents itself for discussion, we are confronted by a somewhat different proposition. In the first place, the ordinary layman cannot find any logical reason for the presence of women students in a Technical school. With a fine scorn which is always apt to attend ignorance of the real situation, he decides that if there are girls in a place like Technology, then only one inference can be drawn: they are there to captivate men instead of to accomplish academic work. In the second place, while we grant that our coeds have the human attributes of our men as well as of our faculty, we must acknowledge that they possess certain traits not shared by many other women, college or otherwise. They have found themselves and have a definite aim in life. They know what they want and, realizing that through no other means than a course at Technology can they obtain this, they are determined to go through with their work although it entails more than a little hardship and embarrassment. Are they inhuman because they have the initiative, the ability, the perseverance to attack, struggle with, and master, courses of study which leave many men floundering and defeated? Are they inhuman because they sacrifice the dorm life and the activities of women's colleges that they may spend their collegiate years to the greatest avail? Are they inhuman because they can be happy in doing work which would be highly distasteful to many of their sex? Are they inhuman because they have set out to become public health officials, scientists, architects, engineers, etc.?

Most decidedly, no. This is a big world. There is room for those of serious purpose in life as well as for those who have none. Instead of being inhuman, the woman at Technology comes nearer to being superhuman. Several coeds have practically earned their way through the Institute at the same time doing very creditable class room work. Should we not, therefore, hail our fair friends with increased respect, realizing that much praise is due them for the splendid way in which they cling to their ideals in carrying through an education involving so much of the distasteful and difficult? Even in the past many women have distinguished themselves in scientific and technical achievement. May we not some day recognize in our contemporary coeds brilliant and distinguished leaders along their chosen lines of activity?

TECHNOLOGY'S TRANSFERS

Figures recently given out by the Registrar's office show that a large part of Technology's student body comes from other colleges. Why do so many men, after at least a year of college experience, pick Tech as the place in which to complete their formal education?

Perhaps the principal reason is the desire to take advantage of Technology's reputation for hard work. Another reason, the weight of which is but slightly appreciated, is the comparatively large amount of humanistic work which Tech requires in connection with all of its engineering courses. Others are superior special equipment and variety of engineering and scientific offerings.

Thus half of us are here for reasons quite remote from those of sentiment which ordinarily dictate the choice of Alma Mater. With this sentiment always goes a large amount of very real and very valuable engineering education: the spirit of "Play up, play up, and play the game" which is, to any man and particularly, we believe, to an engineer a priceless asset.

It is, perhaps, impossible for Tech to have a football team and all that a team implies. Then it is even more essential for the future, both of Tech and Tech men, that we take advantage of every opportunity that is offered in such activities as we do have, and in other ways for the fostering of this spirit; that those of us who come from other schools carry on here with the spirit that we first learned elsewhere; that those of us who are native Tech men partake of the spirit of the Old Grads, one of the finest to be found among any group of men.

"IN THE SPRING ——"

An appeal of the sort we have in mind, seems, by nature, hard to make, especially to a body as heterogeneous as the Technology undergraduates. It seems doubly difficult because of the atmosphere of awkward ignorance in which we must attack the problem. We must therefore beg for some measure of indulgence at the hands of the students for any faulty approach to a subject more or less exotic to the average "brown-bagger."

A conscientious student feels that he may indulge in romantic flights of the imagination during the ten minutes or so a day that it takes him to cross the Harvard Bridge in the ruddy glow of a spring sunset. The poetry of his thought endures no further on his way home. The noise and the dirt, and the crowds, be it on the subway, or the trains, do for that. He may, if he be an early enough riser, feel a flutter or two in the vicinity of his heart at the view of the glories of a New England sunrise. If his poetic sensibilities have not altogether been crushed by the everlasting press of his studies, he may look at this sunrise with a certain sense of self-pity, pity that he cannot spare time for a fuller appreciation of the thousand and one wonders of nature, of which the splendors of a dawn are but the promise. He may yield a few minutes to such enjoyment, grudgingly, for there is no miser as avaricious as a student's conscience; then give himself over anew to his lessons.

Not all of us can be poets. Not all of us want to be. There is, though, in each of us, a capacity more or less developed for the enjoyment of beauty, an enjoyment which, on indulging, we find as pure and unalloyed as any of our other, perhaps, in our eyes, more substantial enthusiasms. This sentiment is fundamental and natural within us, and, as such, is best aroused by the workings of nature. Most of us do not consider it exactly civil or workmanlike for a man, particularly as practical a man as an engineer, to permit his fancy to dabble in such poetical realms. Perhaps it is not.

Still, when we look over a list of the American men of letters, we find not a few of them engineers. One striking example comes to mind, that of one of our most successful novelists, who, by day, constructs lighthouses, — Hopkinson Smith.

Why do these men, successful in other fields, take up letters, that most powerful instrument we have for the portrayal and appreciative study of the wonders that are nature? It must be that they find in it the needed relaxation after an arduous day of the humdrum of their engineering life. Can we not draw example from them? If they, practical men that they are, can afford to spend a few hours here and there in the month out in the country, for the perfect relaxation they find in nature, as much in its infinite variety as in its comeliness, need we chide ourselves as lazy if we find a walk of a few hours every week end in the outskirts or through the parks, so enjoyable?

We are in the midst of spring. The outdoors call us but we are afraid to answer, for the final exams are beginning to loom up threateningly over us. But this is only an added argument to get out in the open from time to time. When that stale feeling does come over us, why not try a country outing instead of black coffee? There are multitudes of places about Boston that make perfect hunting-grounds for the nature lover, such for instance as the Nahant rocks, the upper Charles, the outer reaches of the Fenway, or the Blue Hills. Would it not be worth while to give some of these a try if a few hours would serve to bring you back to classes with the fresh vigor with which you attack a new term?

PRESIDENT NICHOLS

During the sixty odd years of its existence as an educational institution, Technology has been singularly fortunate in having several famous men as Presidents. Rogers conceived the original idea which led to its founding and early organization; Walker succeeded him at a time when rare ability as an educator and executive were sorely needed; Maclaurin took the helm in his turn and made a reputation for himself which will ever endure. Through the combined efforts of these men and of those in whom these men inspired confidence, Technology has grown from an insignificant unknown institution to one of the foremost technical and scientific schools in the world. To the memory of these three great presidents are due the most profound respect and admiration of all.

Today marks the beginning of a new epoch in Technology's history. A man of proven ability, of world-wide fame as a scientist, of enviable reputation as an educator, is about to take up the duties and responsibilities attendant to the presidential chair. Dr. Ernest Fox Nichols, physicist of renown, colleague of our late Dr. Maclaurin, ex-President of Dartmouth, is soon to be our leader.

Technology's life depends upon the continued development of the functions of teaching and research. Technology's future demands the leadership of one who is competent to set the pace in its manifold activity. Technology's rapid growth demands a constantly expanding "White City upon the Charles." Vastly increased enrollment demands the solution of countless problems of applied education. Technology's position as a pioneer in many lines of scientific development requires a rare combination of initiative and natural ability possessed by few men.

Hence, Dr. Nichols' position is to be one not readily filled. We rejoice in his appointment to the chair because we have faith in him. His sincerity and dignity, his kindly personality, his altruistic nature fit him singularly well as a leader of Technology. At Dartmouth, from inauguration to resignation his success as a leader was marked. We believe that his election by the members of the corporation is very fortunate that his acceptance of the position bids well for our future. Let us be firm in our support of the man who seems certain to go down in history as one of Technology's great leaders.

EGOTISM

Perhaps the Tech man who recently said "If a man says he knows all about anything you may be sure he's either a fool or a liar" put his case too bluntly. In any event, he hit the nail of Egotism square on the head.

But go deeper. Sound the man's knowledge. Too often it is with men as with jugs, the less they have in them the more noise made in pouring out their contents. Brag is useless. Supreme confidence in self is dangerous, although if tempered with a keen sense of judgment may become an asset. The balance for which we should strive would seem to be a combination of a firm confidence in self mingled with a wholesome respect of the ideas and opinions of others.

Men who attain the highest degree of success are egotists in no sense. They have long since discovered the folly of assuming their knowledge and ability supreme. Such men are usually better listeners than talkers although when they do render an opinion it is valued because of its source. A man need not belittle himself in casting off his egotist's shell. Indeed it is quite as harmful to acquire that state of mind wherein the importance of other's ideas, opinions, or statements is greatly magnified, wherein doubtful facts are accepted without due regard for their origin, wherein the individual makes his personality subservient to that of all others.

Obviously it is far easier to preach concerning egotism than it is to practice. When one considers, however, how essential it is to character that this trait be not over developed, he may well ask himself if he wouldn't do well to follow the worthy example of the chicken and break away from his shell. The game is worth the candle. Increased respect inevitably comes to him who has cast aside the almighty "I." Try it and see.

THE THERMIONIC VACUUM TUBE AND ITS APPLICATION

Van Der Bijl

McGraw-Hill Book Co., New York, 1920. Illustrated. Price $5.00.

Reviewed by Mr. F. S. Dellenbaugh, Jr., Secretary Research Division, Electrical Engineering Department, M.I.T.

As the title suggests, Dr. Van Der Bijl deals entirely with the vacuum tube. The book is written very intelligibly and deals with the subject in general in a non-mathematical manner, although enough mathematics is introduced to permit further investigations in this direction for those interested. It can be readily understood by anyone, however, whether mathematically inclined or not. Approximately the first half of the book deals rather thoroughly with the principles of electron emission and control and the fundamental principle of the operation of the three electrode vacuum tube. The subsequent chapters then take up definite applications in each of its main functions, the tube being considered first as a rectifier, secondly as an amplifier, and thirdly as an oscillation generator. Each phase is gone into in detail, chiefly from the descriptive point of view, but also with a small amount of mathematical discussion to bring out added information. Since the treatment is mainly of the tube itself, not many circuit combinations are given, but a few typical examples are shown for each type of connection. The illustration of different types of tubes are particularly good and broad in their field. The next to the last chapter discusses the detection of currents with the vacuum tube in considerable detail, and the book closes with miscellaneous uses along other lines—as a voltmeter, as a power limiting device, and in other special applications.

The volume is not intended in any way to be a handbook of any specific phases of the use of the vacuum tube; but it gives the general theory and characteristics of the tubes in a very clear and thorough manner, and the principles developed can be applied to any of the various uses to which the vacuum tube is put. It is comprehensive and reasonably concise, somewhat elementary but very thorough.

MAN'S UPWARD CLIMB

(*Continued from Page 3*)

result of an awakening of the brute through a breathing into it of a quickening spirit. According to either of these theories man is a combination of the typical man-like qualities and of many traits inherited along with his brute body. With his brute body, man inherits, in common with all animals from the microscopic protozoon up, the three primary instincts of self-preservation, nutrition, and reproduction. All structures have been built around these three primary desires, and thus, even man instinctively expresses them, though he may pit against them a more lately acquired desire, and give his life for another, or go on a hunger strike for a cause in which he believes. With his body he also inherits the instinct to care for his offspring; this parental instinct made its first appearance with the higher types of fish. Similarly with other mammals man inherits the herd instinct; that is, he is susceptible to leadership, is subject to the passions of the pack as is seen in times of panic and mob violence, and largely governs his life according to the will of the majority.

Not only does man possess these instincts in common with his brutish confreres, but they make their appearance upon earth in true evolutionary order,—the higher instincts later than the lower ones. If we place these instincts in chart form we note that the three primary instincts must have appeared with the first animal or else there could have been no continuance of life. Parental care, judging from the behavior of living animals most nearly related to those found fossil, made its appearance very much later, while considerably later still, herd instinct was exhibited by earth dwelling animals.

In addition to this gradual expansion of consciousness through the avenues of instincts, man's pre-human forbears constantly gained a larger control over their surroundings through the increasing mass of knowledge possessed by the tribe as an inheritance from the past. The lowest animals have only the knowledge (i.e. ability, instinct) with which they are born. Each may add a very slight amount to his own inheritance during his life but can teach none of what he learns to his offspring. With the appearance of parental instinct, however, there enters the imitation of parent by offspring, hence some knowledge is continued as a sort of tradition in addition to that handed down through the generations by birth inheritance. And with the coming of the herd, the young, associating intimately and long with many more than his parents, finds his imitative faculty expanded and the knowledge of his environment greatly broadened.

Mankind continues, at a more rapid rate, the evolution begun by pre-human animals. Many of the stages in man's development survive with us today in the many savage and semi-civilized tribes; and fossil remains of early man and his art not only corroborate this evidence, but give us their order or appearance in time. Earliest man is shown to have had very slight control over his surroundings indeed. He made use of such sticks and stones as he found for his weapons and his tools, and used trees or caves for his house. He merely appropriated from nature. Very slowly he learned to adapt what he took from nature to his own ends. He no longer used a simple log to cross a stream, but hollowed it out and formed a boat. Much later still, when his faculties had expanded and his accumulated knowledge from the past had greatly increased, he became creative. He made cloth from plants, and bricks from clay. At first after reaching this stage of expansion he continued to use stone as his most efficient weapon and tool (the neolithic age.) Later he learned the use of metals; at first bronze, later iron. At a considerably later date he learned to use gunpowder and its derivatives in warfare and in the arts. This stage, which continues to the present, we may call with Slosson the nitrogen age, as nitrogen forms the basis of so much of our life, from manufactures and agriculture down to warfare.

Step by step with this increasing control by man over his surroundings, is the increasingly rapid enlargement of knowledge from the past. Our pre-human ancestors had begun this line of advance, but reasoning man carried it ever more and more rapidly forward. The elaboration of articulate speech, which gave to man such a vast enlargement of the power of co-operation, progressed very slowly at first and could not have reached even a moderate degree of development before the neolithic stage of advancement. In the later paleolithic, and especially with the neolithic stage of development writing was evolved. At first it was confined to picture writing (drawings of things and acts with dots and dashes for quantitative ideas as with the American Indians), later it passed to the conventionalized form of more rapid use of stylus or brush, as with the Chinese. When adopted by conquerors, or other alien peoples, it became a sign-for-a-sound writing. In one direction, syllable writing as the writing of the Babylonians, Assyrians and Chaldeans, which was developed from the ancient Sumerian picture writing; or in another direction, letter writing, as of the Phonecians, Greeks, Romans and English, which was developed from the ancient Egyptian picture writing.

From now on human tradition became more full and more exact. Men's thoughts could affect others at a distance both in space and in time, hence a tremendous impetus was given to further development. Finally with printing, writing became cheap and thus the common heritage of all mankind. Hence more and more, the world over, men are learning to read, reaching towards the vast store of knowledge already accumulated in books, and urging themselves ever more and more rapidly to higher and higher levels.

SOME STEPS IN MAN'S UPWARD CLIMB

Earliest appearance	Individual Evolution			Social Evolution (Through Storage of Knowledge from the Past)
		(Stage)	(Age)	Printing; Writing; Elaboration of Articulate Speech; Tradition through the Herd; Tradition through Parents; Through Birth Inheritance only
Cenozoic (Late)	4. Self-Consciousness and reason (Man)	Creative	Nitrogen	
			Iron	
			Bronze	
			Neolithic	
		Adaptive	Paleolithic	
		Appropriative	Eolithic	
Cenozoic (Early)	3. Herd Instinct (Mammals)			
Mesozoic	2. Parental Care (Higher Fish to Man)			
Archeozoic	1. Three Primary Instincts (All animals) (Self-Preservation, nutrition, reproduction)			

"—but the wire has no hole for electricity to flow through"

IT was a lawyer talking, and when he made this brilliant observation an engineer present couldn't help chuckling.

How absurd, he thought, that anybody could be so ignorant of the properties of current electricity.

But by the way, oh stern critic, what are mechanics' liens and what are the mutual obligations of partners? When the talk turns to law or business or the seven arts, have you opinions to express and can you express them without the fear of making a "break"?

Looked at in this light there seems to be some sense to the argument for a broad curriculum for engineers.

Though your object should be first and foremost to find out more than anybody else knows about some specialized phase of engineering, don't miss any chance to get acquainted with every common interest which may influence the social and industrial life of the day.

This is nothing but a matter of good business. It will enable you to meet men on their own ground.

And because life is too full to learn everything about everything, this habit teaches the greatest lesson of all—the necessity of getting at fundamentals and applying basic principles already learned to each new problem.

It is this attitude of mind which will earn you a place in the inner office where they discuss, not details, you may be sure, but policies.

* * *

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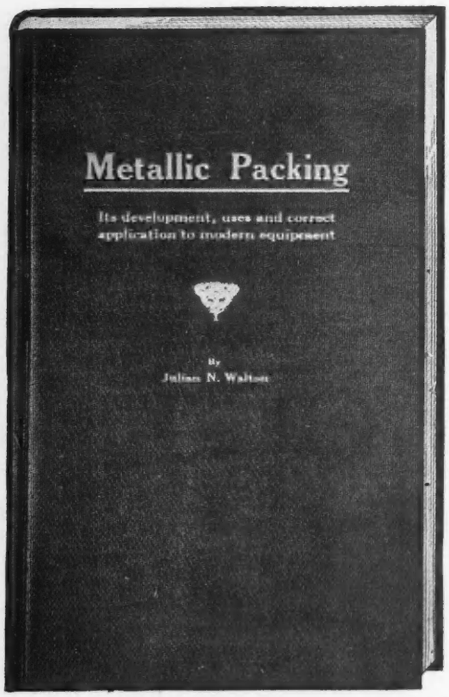

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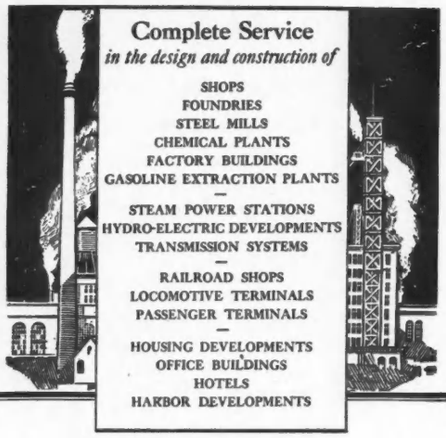

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OUR NEXT PRESIDENT

(Continued from Page 7)

is today by filling in the background, physical, mental, and spiritual, out of which he has come in obedience to law. The whole current of college life should be so directed as to foster the finer qualities of mind and spirit which give men dignity, poise and that deeper sense of honorable and unselfish devotion to the great and common good."

It would seem that Dr. Nichols favors the plan of prescribed subjects of study as followed here at Technology rather than the group or elective systems found in some colleges. On the elective system his views are:

"Under this unhappy system, or lack of system, for every student who gains a distinct advantage by its license several of his less purposeful companions seek and find a path of least resistance, enjoys comfort and ease in following it, and emerge at the other end, four years older, but no more capable of service than when they entered. Many another youth, neither lazy nor idle, but lacking both rudder and chart, angles diligently in shallow waters, goes no deeper than the introductory course in any department, comes out with many topics for conversation, but no real mental discipline and but little power to think."

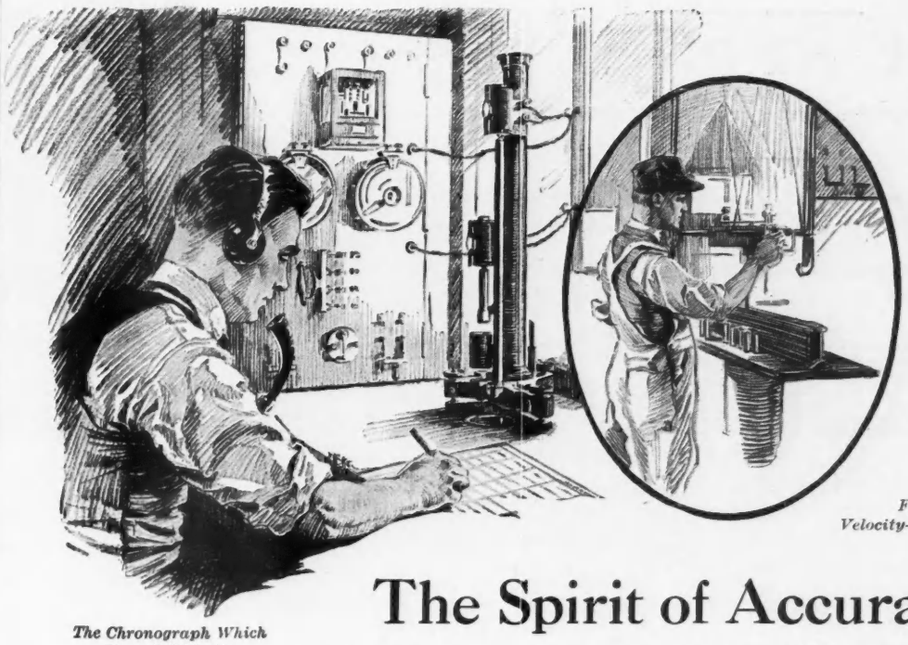
Dr. Nichols' views on the reasons for the selection of a course would naturally fall upon a sound basis. He would have ability the basis of selection:—"Enthusiastic parents, heedless of taste and fitness, too often urge their sons into scientific pursuits, not realizing that lack of intellectual preference in a boy is inadequate proof that he possesses that balanced mind which scientific investigation requires, and unusual pleasure at riding in an electric car is insufficient evidence of a marked capacity for electrical engineering."

He also believes in personal effort as the only logical means of procuring an education. His views on this matter are an indication of his characteristic ability to appreciate human nature.

"Whatever knowledge and trained faculties a student may have acquired at graduation depend more upon the man and less upon the college. Colleges may provide the richest opportunities and the fullest incentive, but that which lies beyond is work the student must do himself. College, like life, is whatever the man has industry, ability and insight to make of it. 'They also serve who only stand and wait' was written to console blindness and advancing years, not as an apology for strength and youth."

As a great investigator and teacher, his own views on what a teacher ought to be are well worth knowing. He says: "We need special knowledge in college teachers, but not specialized men."

(Continued on Page 18)



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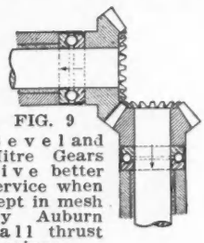

FIG. 9
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"Ferro-Alloys and Steel Making Metals in 1920;" R. J. Anderson; Iron Age, 107; 73-76.

"Gasoline by the Charcoal Absorption Process;" G. A. Burrell; G. G. Oberfeil and C. L. Voress; Chem. & Met. Eng., 24; 156-160.

"Textile Research," L. A. Olney; American Dyestuff Reporter, 7; Sect. 2, 11-12.

"History of Helium and its Production;" R. T. Elworthy; Canadian Chemistry and Metallurgy, 5 7-9.

"Action of Light on Rubber;" B. D. Porrett; India Rubber Journal, 60; 21-24.

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OUR NEXT PRESIDENT

(Continued from Page 14)

There is probably no better example of the philosophy of this great scholar, and secret of his success than in the following statement:

"Science in the university may have misled the thoughtless to some extent by an emotionless discussion of facts, but facts should be discussed without emotion; it is the lifeless statement of purpose from which we suffer. The driving power of intellect is enthusiasm, and there is no lack of it in that passionate devotion to research which so painstakingly and properly excludes all warmth from its calm statement of results. Yet there is nothing short of a divine zeal, an irresistible force, which urges the true investigator on to those great achievements, which are so profoundly changing the habits of our daily life and thought. For any mental indifference therefore, be it real or assumed, science is in no way responsible. Science takes herself seriously and is always in deadly earnest."

These selections illustrate Dr. Nichols' charming style and sound judgment on humanistic problems. His dignity and loyalty; his firmness tempered with a vein of sentiment; his appreciation of art, literature, and music; his ability to view a situation with cool and unprejudiced reason; and his great altruism which has kept him at serviceable tasks for which the world offers little material reward, are all qualities which do much to fit him as a leader for young men. He says: "The vast majority of college men are sound in mind and heart and purpose and no young men are ever worthier of admiration and respect than these."

TO OUR FRIENDS

This issue of THE TECH ENGINEERING NEWS is the first of Volume II. As we look back over the past year, we feel that real progress has been made and that we have striven to fulfill a want among Institute publications. We shall continue in our endeavor to make our publication increasingly serviceable and trust that our efforts will meet with the pleasure of both the undergraduates and alumni.

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To be admitted to the Institute, the applicant must have attained the age of seventeen years and must pass examinations in Algebra, Plane and Solid Geometry, Physics, Trigonometry, English, French or German. Certificate of preparation in two units of a series of elective subjects is also required. The requirement in History may be met by the presentation of a school record of certificate grade. A division of these examinations between different examination periods is allowed. In general a faithful student who has passed creditably through a good high school, having two years' study of French and German or three years of French or German should be able to pass the Institute examinations.

Graduates of colleges, and in general all applicants presenting certificates representing work done at other colleges, are excused from the usual entrance examinations and from any subjects already satisfactorily completed. Records of the College Entrance Examination Board, which holds examinations at many points throughout the country and in Europe, are also accepted for admission to the Institute.

Instruction is given by means of lectures and recitations, in connection with appropriate work in the laboratory, drawing-room or field. To this end, extensive laboratories of Chemistry, Physics, Biology, Mining, Mechanical Engineering, Applied Mechanics, and the Mechanics Arts have been thoroughly equipped, and unusual opportunities for field-work and for the examination of existing structures and industries have been secured. The co-operative course in Electrical Engineering and that in Chemical Engineering Practice afford an unusual opportunity to combine a technical training with a direct contact with the industries.

The regular courses are of four years' duration, and lead to the degree of Bachelor of Science. In most courses the work may also be distributed over five years by students who prefer to do so. Special students are admitted to work for which they are qualified; and the degree of Master of Science, Doctor of Philosophy, and Doctor of Science are given for resident study subsequent to graduation. Opportunity for research is offered in all the departmental laboratories and in the Research Laboratories of Applied Chemistry, Electrical Engineering, Industrial Physics and Physical Chemistry.

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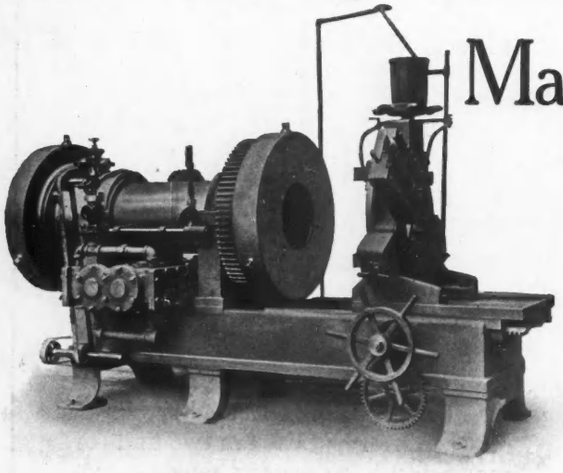

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CONCRETE ROAD CONSTRUCTION

(*Continued from Page 5*)

crown. I believe this to be the best method where it is practical to use it.

When the temperature gets down to 35 degrees, no concrete should be laid without heating the material. No concreting should be done on a frozen subgrade.

Special canvas or strips of tar paper should be available for protection in case of a sudden rain, before the concrete is set sufficiently to cover. This tar paper is also sometimes used for covering when the temperature is falling rapidly toward the freezing point and the concrete is getting its initial set slowly. It is then covered with hay.

The finished road should not be opened to traffic before 3 weeks' time even in warm weather. In cool weather, this period should be lengthened. If it appears necessary to open the road to travel at the end of three weeks, when the temperature for setting has not been favorable, the surface should be protected by an insulating or shock absorbing layer of earth six inches or more in thickness.

Joints and Reinforcement

Many laboratory tests have been made which, in connection with actual construction experience, would seem to indicate that concrete contracts more in setting and drying than it ever afterward expands from the combined effects of high temperature and moisture.

Observed results indicate that contraction cracks occur at intervals of from two to three times the width of the club. As a straight crack is much more sightly than an irregular one, joints should be placed every 35 to 40 ft. These joints need be only the thickness of a piece of tar paper. Joints should be square across the road and perpendicular to the top surface.

TOPOGRAPHIC DRAFTSMEN

The U. S. Civil Service Commission announces that it desires an indefinite number of applications for completion exams in Hydrographic and Topographic Draftsmanship. These exams are open to both men and women citizens. The positions pay from $1600 to $2000 per year.

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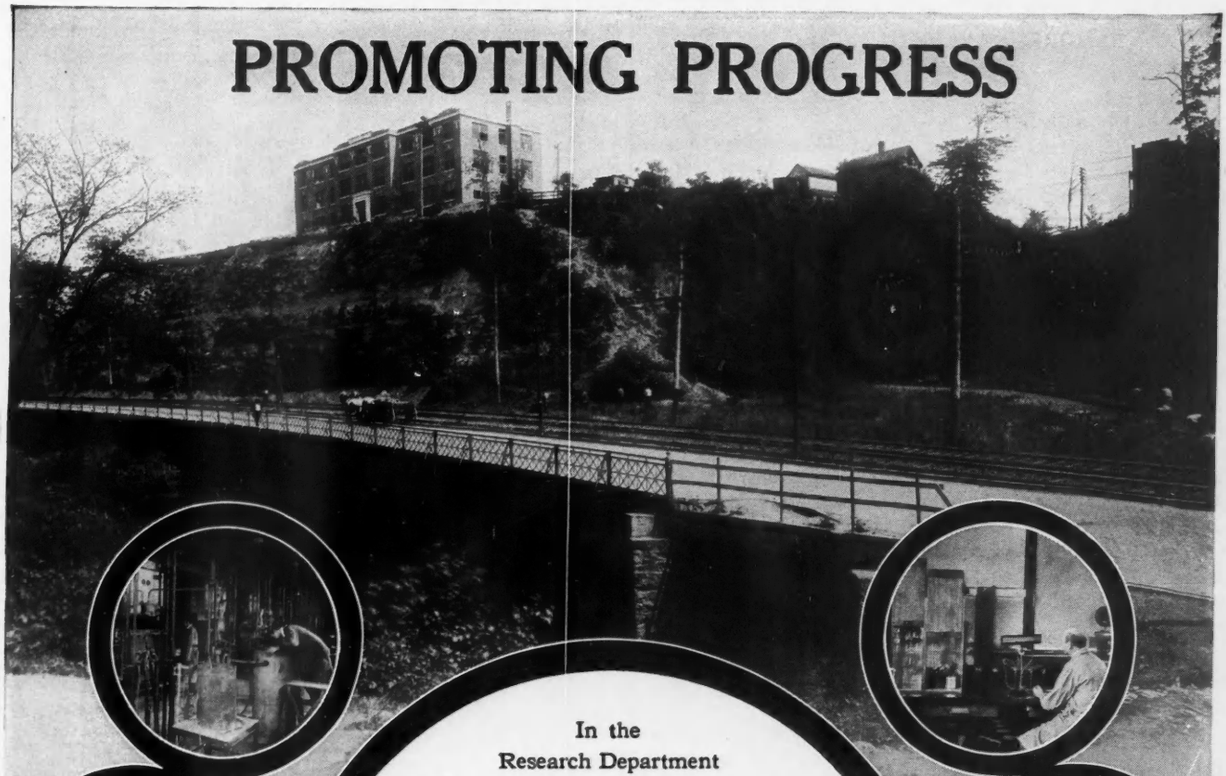

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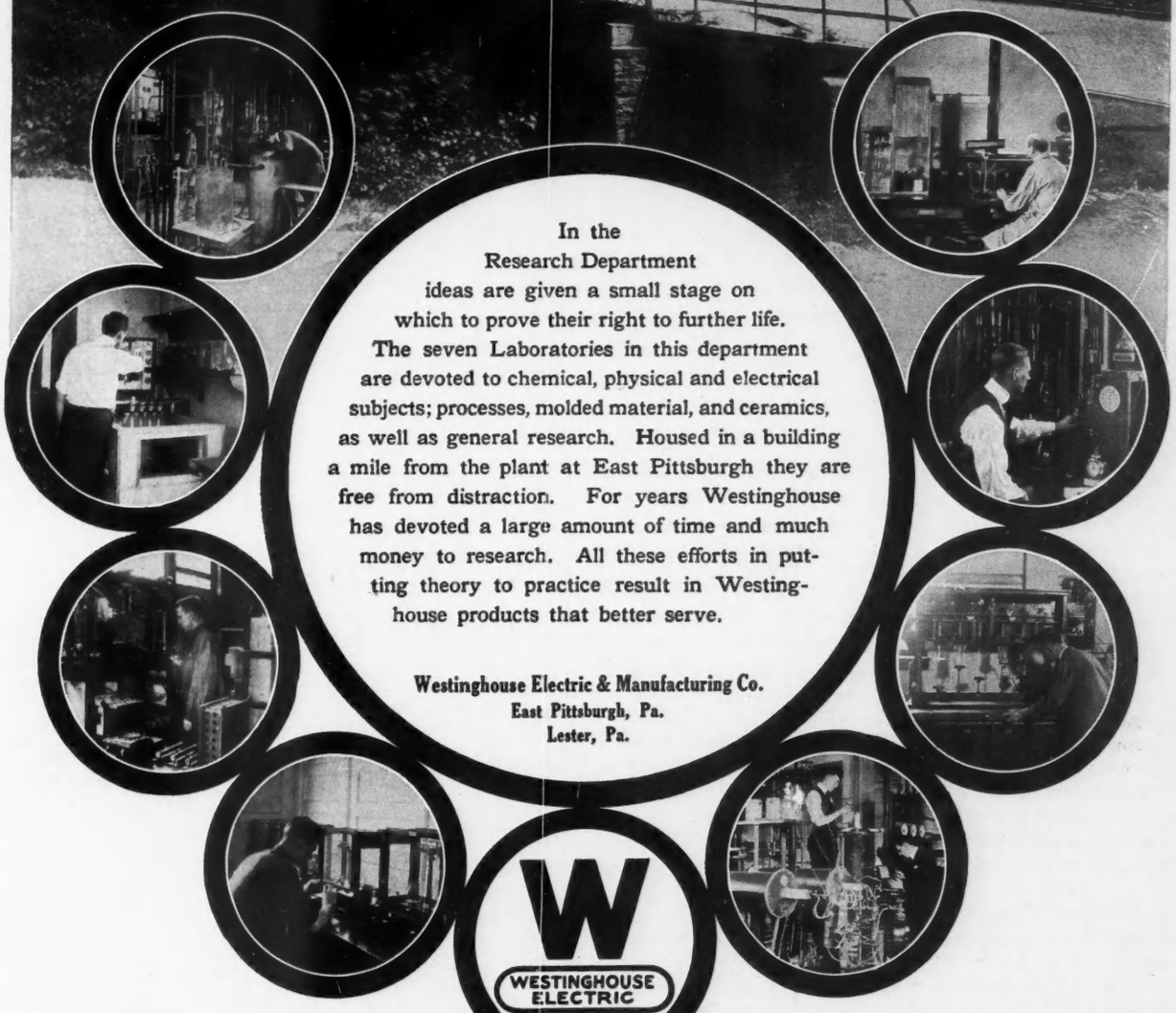

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BRINGING MORE DAYLIGHT INTO INDUSTRIAL BUILDINGS

Dr. George M. Price, writing on "The Importance of Light in Factories," in "The Modern Factory," states: 'Light is an essential working condition in all industrial establishments, and is also of paramount influence in the preservation of the health of the workers. There is no condition within industrial establishments to which so little attention is given as proper lighting and illumination. Especially is this the case in many of the factories in the United States. A prominent investigator, who had extensive opportunities to make observations of industrial establishments in Europe as well as in America, states: "I have seen so many mills and other works miserably lighted, that bad light is the most conspicuous and general defect of American factory premises."

"My own investigations for the New York State Factory Commission support this view. In these investigations it was found that 36.7% of the laundries inspected, 49.2% of the candy factories, 48.4% of the printing places, 50% of the chemical establishments, were inadequately lighted. There was hardly a trade investigated without finding a large number of inadequately lighted establishments."

Inadequate and defective lighting of industrial buildings is not confined to the establishments in New York State alone. The same conditions prevail in most sections of the country.

Such conditions as mentioned above are entirely opposed to the laws of health, sanitation and efficiency. Wherever poor lighting conditions prevail, there must be a corresponding loss of efficiency and output both in quality and in quantity. American industry is not using nearly enough daylight and sunlight in its buildings. Every endeavor should be made to use as much as possible of daylight for lighting purposes. To obtain this it is of course necessary that the rays of daylight and sunlight are permitted to enter the interior of the buildings as freely as possible, with the important modification that the direct rays of the sun must be properly diffused to prevent glare and eyestrain. A glass especially made for this purpose is known as Factrolite, and is recommended for the windows of industrial plants. Windows should be kept clean if the maximum amount of daylight is to pass through the glass, but the effort will be well repaid by the benefits secured.

In the presence of poor lighting, we cannot expect men to work with the same enthusiasm as when a well lighted working place has been provided. The physical surroundings have a deep effect upon the sentiments of the employes, and where bad working conditions are allowed to prevail, there is invariably a lessening of morale and satisfaction created thereby. Neglecting to utilize what nature has so bounteously provided, daylight, and which is so essential toward industrial efficiency, we have an instance of wastefulness, but now that the importance of good lighting is becoming recognized, undoubtedly more attention will be given by progressive industrial employers to furnishing the means which are essential for their workers to secure and maintain the efficiency, which counts for so much in the success of any industrial concern in this competitive age.

If you are interested in the distribution of light through Factrolite, we will send you a copy of Laboratory Report—"Factrolited."

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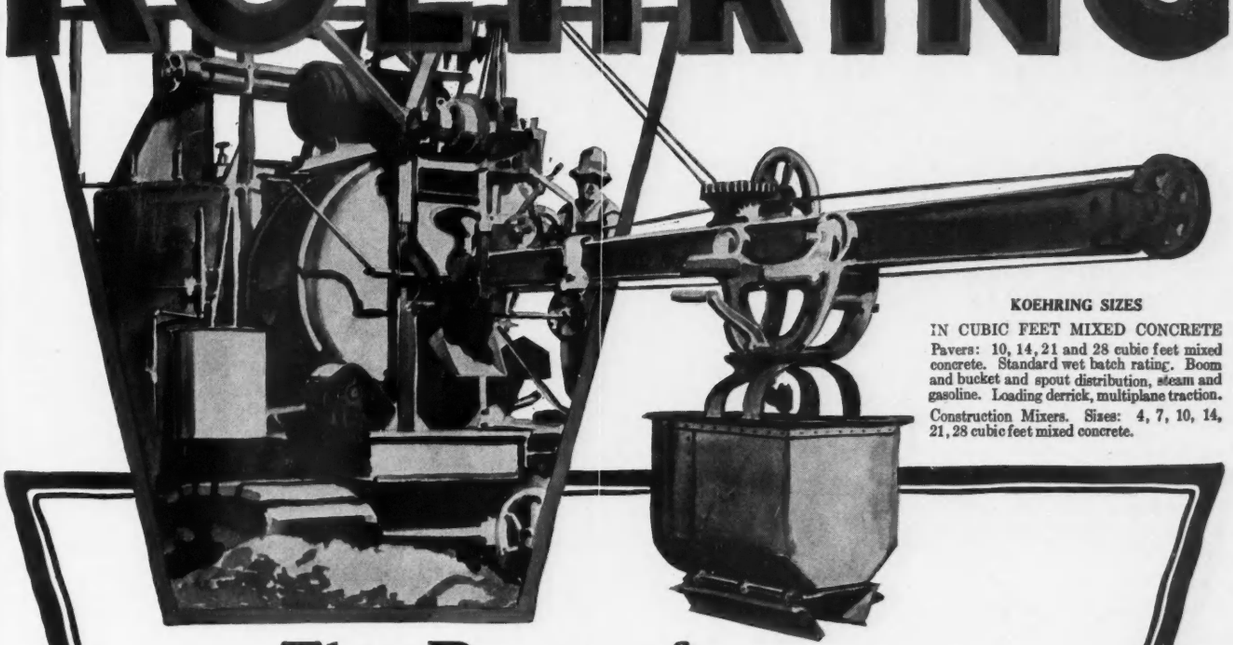

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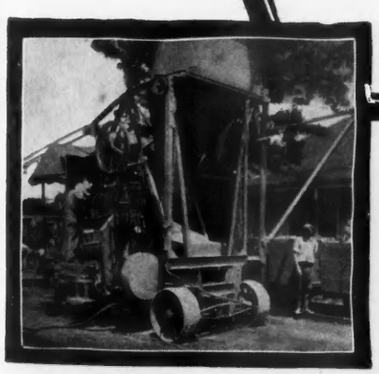

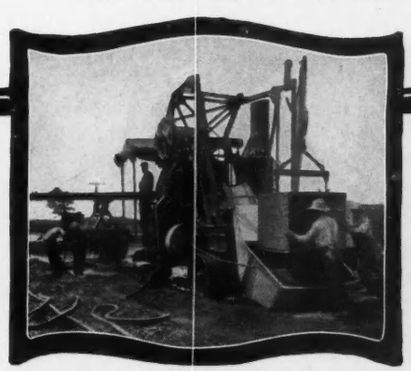

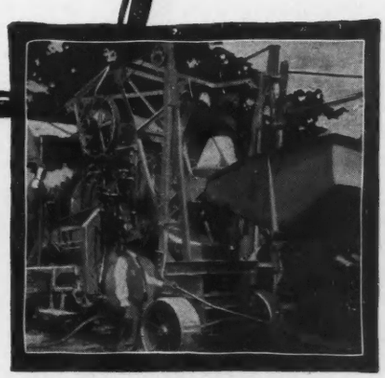

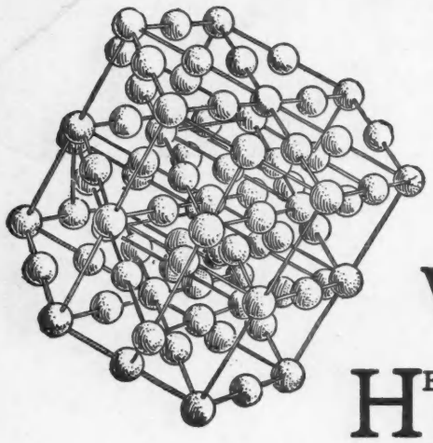

Who Was Moseley?

HE was a young Oxford man, only twenty-seven when he was killed at Gallipoli. Up to his time, man had never seen the inside of an atom. . He turned the X-rays on matter—not figuratively but literally—and made them disclose the skeleton of an atom just as certainly as a surgeon makes them reveal the positions of the bones of the body. Moseley proved that all atoms are built up of the same kind of matter. He saw, too, just why an atom of copper is different from an atom of gold.

Atoms are built up of electrons. Each atom consists of a nucleus, a kind of sun, with a certain number of electrons grouped about it, like planets. Moseley actually counted the number of electrons of all the metals from aluminum to gold.

When you discover what gold is made of or a new fact about electricity, you open up new possibilities for the use of gold or electricity. For that reason the Research Laboratories of the General Electric Company are as much concerned with the "how" of things—atoms and electrons, for instance—as they are with mere applications of the electric current.

Hence Moseley's work has been continued in the Research Laboratories, with the result that more has been learned about matter. How does water freeze? What is lead? Why are lead, iron, gold and tungsten malleable? Such questions can be answered more definitely now than ten years ago. And because they can be answered it is possible to make more rapid progress in illumination, in X-ray photography, in wireless telegraphy, and in elec trical engineering as a whole.

There would have been no coal-tar industry without the vast amount of research conducted in organic chemistry, and no electro-chemical industry without such work as Sir Humphrey Davey's purely scientific study of an electric current's effect on caustic potash and caustic soda. Sooner or later research in pure science always enriches the world with discoveries that can be practically applied. For these reasons the Research Laboratories of the General Electric Company devote so much time to the study of purely scientific problems.

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